Faculty of Science

MATB33, Mathematics: Introduction to Higher Analysis, 7.5 credits

Matematik: Introduktion till högre analys, 7,5 högskolepoäng

First Cycle / Grundnivå

Details of approval

The syllabus was approved by The Education Board of Faculty of Science on 2024-06-05. The syllabus comes into effect 2024-06-05 and is valid from the spring semester 2025.

General information

The course is a compulsory course for first-cycle studies for a Bachelor of Science degree in mathematics. The course is part of the second semester's studies within the Bachelor's programme in mathematics and is intended to be read in parallel with a course in analysis in several variables. The course can also be given as a stand-alone course or as part of a course package.

Language of instruction: English

Main field of study	*Specialisation*
Mathematics	G1F, First cycle, has less than 60 credits in first-cycle course/s as entry requirements

Learning outcomes

The overarching goal of the course is for students to develop understanding of central concepts, results and methods of relevance for further studies that involve mathematical analysis. The course is designed to enhance students' abilities to communicate mathematical ideas effectively in both speech and writing, and to improve their skills in reading mathematical texts. Additionally, the course aims to expose students to research literature in mathematics.

Knowledge and understanding

On completion of the course, the student should be able to:

- give a detailed account of the concepts and definitions that are listed under the contents of the course,
- explain the logical relation between the most important axioms, definitions and theorems included in the course,
- explain how the results of this course are related to, and generalise, results from courses in analysis in one and several variables.
- explain why axioms, definitions, theorems and proofs are necessary when developing a mathematical theory

Competence and skills

On completion of the course, the student should be able to:

- use the most important axioms, definitions and theorems included in the course to solve problems in mathematical analysis
- perform routine calculations neccessary for solving problems in mathematical analysis within the course frame
- reproduce proofs of the most important theorems included in the course, as well as be able to derive relations between key concepts
- numerically, analytically and visually illustrate concepts related to convergence
- present mathematical problems, solutions and arguments within course framework, in speech and writing, logically coherent and with good terminology
- critically assess and give constructive feedback on other students' work
- perform assignments within a given time frame.

Judgement and approach

On completion of the course, the student should be able to:

- relate, by giving examples, the contents of the course to use of mathematical analysis in mathematical research
- concretise, by giving examples, abstract mathematical concepts within the course frame
- argue for the significance of mathematical analysis for higher mathematics
- identify their need to aquire further knowledge.

Course content

The course treats:

- Properties of the real numbers R: completeness axiom, Cauchy sequences, cardinality of rational and irrational numbers.
- Topology in R^n: open and closed sets, p-norms, convergence, compactness and the Bolzano-Weierstrass theorem, connected sets.
- Continuous functions in R^n: intermediate value theorem, min-max theorem, uniform continuity, continuity of inverse functions, implicit function theorem.

- Convergence of sequences and series of functions: pointwise, absolute and uniform convergence, termwise differentiation and integration, power series.
- Examples of applications to selected topics relevant to mathematical research at the centre for mathematical sciences.

Course design

The teaching consists of lectures and seminars. A mandatory project assignment is included in the course.

Assessment

The examination consists of the following parts:

- project assignment (2.5 credits)
- written examination at the end of the course (2.5 credits)
- oral examination at the end of the course (2.5 credits)

The project assignment is examined in writing during the course and presented orally at the end of the course. Peer response is included in the requirements for the project.

The oral examination is only given to those students who have passed the written examination and also concerns questions about the project assignment.

Students who do not pass the regular examination are offered an additional examination opportunity during the scheduled re-examination period.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Grades

Grading scale includes the grades: Fail, Pass, Pass with distinction
The grading scale for the project assignment and the written examination is Fail, Pass, while the oral examination is graded according to the grading scale Fail, Pass, Pass with distinction.

In order to obtian the grade Pass on the entire course, it is required to pass the project assignment as well as the written and oral examinations. The final grade for the entire course is determined by the grade on the oral examination.

Entry requirements

Admission to the course requires at least 30 credits in mathematics including knowledge corresponding to MATA31 Analysis in One Variable, 15 credits, MATA32 Algebra and Vector Geometry, 7.5 credits and NUMA01 Computational Programming with Python, 7.5 credits.

Further information

The course is included in the second semester of studies within the Bachelor's programme in mathematics together with the courses MATB21 Analysis in Several Variables 1, 7.5 credits, MATB23 Analysis in Several Variables 2, 7.5 credits and MATB32 Linear algebra, 7.5 credits. In order to be able assimilate the course content, it is recommended that the students either have read or are taking a course in analysis

in several variables in parallel.

The course is given at the Centre for Mathematical Sciences, Lund University.